

Temperature Studies of Spatial Modulations in Thin Films on Ag(100) Surfaces

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Beamline: X16A,B,C

Introduction: As previously observed at this beamline, thin films of Cu deposited on Ag(100) undergo a transformation to a modulated phase after a depth of approximately 10 monolayers. Part of the explanation for this is that on Ag(100) the Cu film grows epitaxially as BCC due to the lattice mismatch. After a critical depth is reached the Cu film relaxes towards its equilibrium structure of FCC. This relaxation is characterized by satellites appearing at approximate positions $(0, 1 \pm n\delta, 1.4 \mp 1.4n\delta)$. By analogy with electrochemical experiments, it is assumed that there is a striped morphology with domains.

Procedure: The current experiment has involved studying the temperature dependence of the evolution of the stripe spacing. For this we used UHV methods at the *in situ* X16A beamline. We prepared our samples by sputtering at room temperature and annealing at high temperature (650°C). Vapor deposition from a Knudsen cell was typically carried out at a rate of 2-5 monolayers per hour. The temperature of the sample during deposition was controlled between -40°C and 150°C through either resistive heating or by liquid nitrogen flow through the sample arm. Diffraction was measured with respect to a body-centered tetragonal (BCT) Ag unit cell. Diagonal scans in the $(0\ 1\ -1.4)$ direction through the Cu peak appearing at $(0\ 1\ 1.4)$ in the Ag BCT notation show satellite peaks forming and moving inward with increasing deposition, as evident in figure 1. The inverse of the peak spacing δ , as shown in figure 2, gives the spacing between stripes in units of Ag lattice spacings. The linear trend of the stripe spacing constrains the possible structural models of the film.

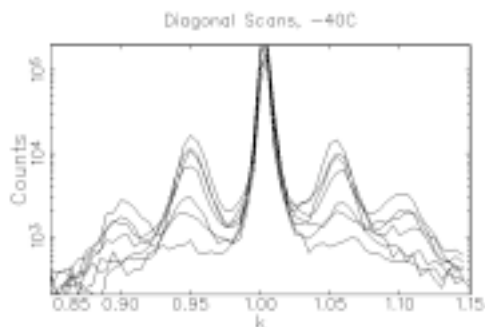


Figure 1. Typical diagonal scans. The lowest curves are the earliest, with peaks forming and moving inward as deposition continues.

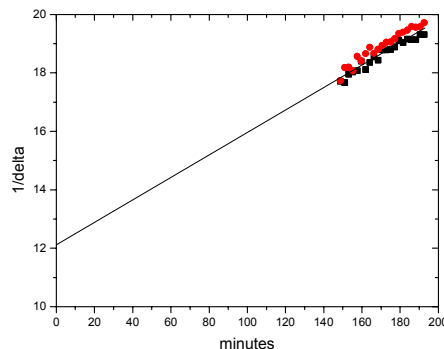


Figure 2. The inverse of the satellite spacing over time. The linear trend and intercept limit the possible models.